Ann. Natal Mus. Vol. 21(2) Pages 439–453 Pietermaritzburg December 1972

A description of the female, egg and first-instar larva of Tongamya miranda, with notes on oviposition and the habitat of the species (Diptera: Apioceridae)

by

M. E. Irwin and B. R. Stuckenberg

(Natal Museum, Pietermaritzburg)

SYNOPSIS

The female of the megasceline apiocerid *Tongamya miranda* Stuckenberg is described for the first time and proves to have the same unusual features of head structure possessed by the male. The eggs are described; they are relatively small and laid in batches averaging 101 eggs; over a thousand may be laid by one female. The first-instar larva is described and figured. Brief notes are given on the hatching sequence and feeding of first-instar larvae. The use of grasstufts for perching by the females is noted. Finally, all published data on immature stages of Apioceridae are reviewed.

INTRODUCTION

The family Apioceridae is sparsely represented in the Ethiopian Region where the only taxa recorded so far are three South African species in the widespread genus *Apiocera* Westwood (Stuckenberg, 1968) and the endemic genus and species *Tongamya miranda* Stuckenberg (1966) found in northern Zululand. The genus *Tongamya* is of special interest because of its inclusion in the geographically disjunct subfamily Megascelinae; this subfamily contains only two other genera, *Megascelus* Philippi in Chile and *Neorhaphiomydas* Norris in Western Australia.

When *Tongamya miranda* was described, five specimens of only the male sex were available. During a visit to Zululand in November 1971, one of us (M.E.I.) collected seven females at a site about 32 km from the type locality; several of these specimens laid eggs in the laboratory, from which many first-instar larvae emerged. The only published accounts of apiocerid immature stages are by English (1946), dealing with the final-instar larva of the Australian *Apiocera maritima* Hardy, and Cazier (1963) who described superficially the first-instar larva and egg of the Nearctic *Apiocera painteri* Cazier.

Because of the interest arising from the location of *Tongamya* in the Megascelinae and the scantiness of knowledge of apiocerid biology and immature stages, as well as complete lack of published information on the eggs and larvae of the Megascelinae in particular, descriptions are presented below of the female, first-instar larva and eggs of *miranda*, and records are given of observations made on oviposition and habitat.

DESCRIPTION OF FEMALE *TONGAMYA MIRANDA* STUCKENBERG

Tongamya miranda Stuckenberg, 1966, *Rev. Zool. Bot. Afr.* **73**: 110–119

The extraordinary morphological features of the head noted in the original description of the male occur also in the female, namely very reduced, rudimentary mouthparts, two

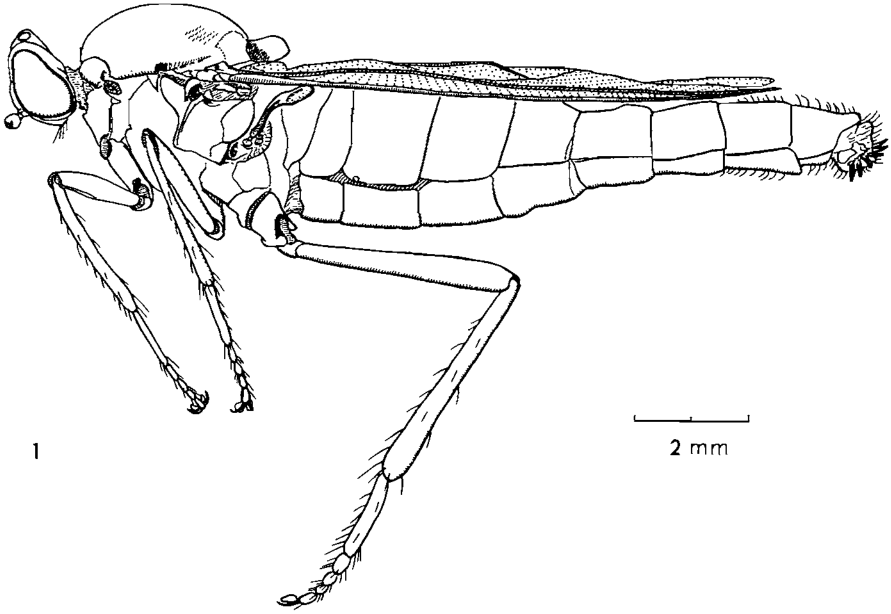

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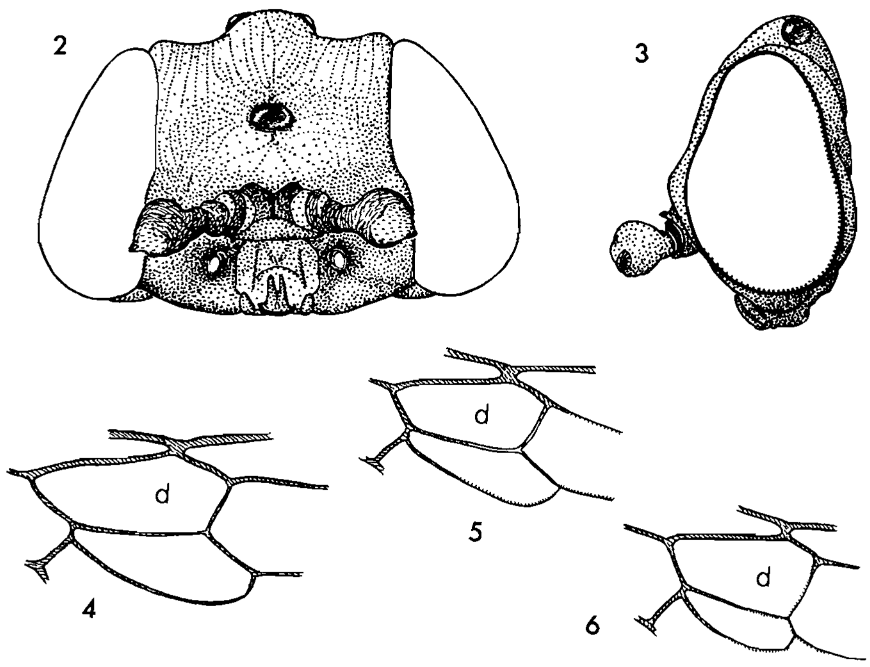
Fig. 1. *Tongamya miranda* Stuckenberg, female.



Figs 2–6. Female: (2,3) head in frontal and lateral views; (4–6) three forms of the subdiscal cell, d = discal cell.

tunnel-like cavities through the head from face to occiput, formed by the union of the anterior and posterior tentorial pits, location of the anterior ocellus in the centre of the frons remote from the hind ocelli, and enormous size of the anterior ocellus. Sexual characters of the female (fig. 1) are: the larger size; proportionately smaller, shallower head, obviously dichoptic, with wide frons; uniform facet size of eye; more boldly patterned wing (possibly not a sexual feature but correlated with degree of maturity); usually closed subdiscal cell; more elongate abdomen, swollen over basal half; and division of ninth tergite into two smaller basal parts and larger, proximal, semi-annular acanthophorites narrowly united dorsally, each bearing a circlet of strong spines.

Head (figs 2, 3) shaped almost as in male, width 2,28–3,00 mm (mean of six, 2,6 mm), always slightly wider than mesonotum which at its widest is 88–98% (mean of six, 94%) of head width; in shape strongly transverse, shallow in longitudinal axis, uniformly 1,5 × wider than high, widest at level of lowermost quarter which is at upper margin of face. Eyes undivided with uniform facets, widely separated, width of frons across anterior ocellus (see fig. 2) 1,13–1,50 mm (mean of six, 1,28 mm), 49–51% of greatest head width (mean of six, 50%), frons obviously wider than high, shallowly concave around anterior ocellus. Vertex rounded, elevated on sides above eye margins, produced into a prominently raised ocellar tubercle. Anterior ocellus remote from hind ocelli, situated in middle of frons, enormously enlarged, lustrous, its shape roughly similar to that of head, broadest near lower edge; hind ocelli on postero-lateral sides of tubercle, conspicuously large. Entire frons with numerous irregular grooves, those on upper sides and anterior surface of tubercle frequently subparallel, those in central depression radiating in somewhat indefinite fashion towards anterior ocellus. Antennae as in ♂, separated by a biconcave sclerite. Face and mouthparts as in ♂.

Thorax and legs as in ♂, but tibiae with more conspicuous, stiff setae; hind tibiae and basitarsus less obviously swollen. The unusually great relative length and strength of hind legs apparently correlated with clinging behaviour in grasstufts, described below.

Wing as in ♂, except that in all but one ♀ the subdiscal cell is closed apically instead of being open, this cell varying in form (figs 4–6). Wing pattern variably developed, possibly correlated with age, an apparently mature specimen shown in fig. 7; membrane greyish, usually at least the leading edge (costal and subcostal cells) smoky brown, major veins

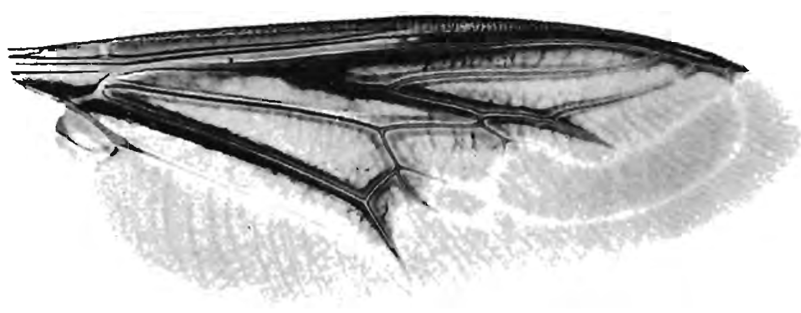
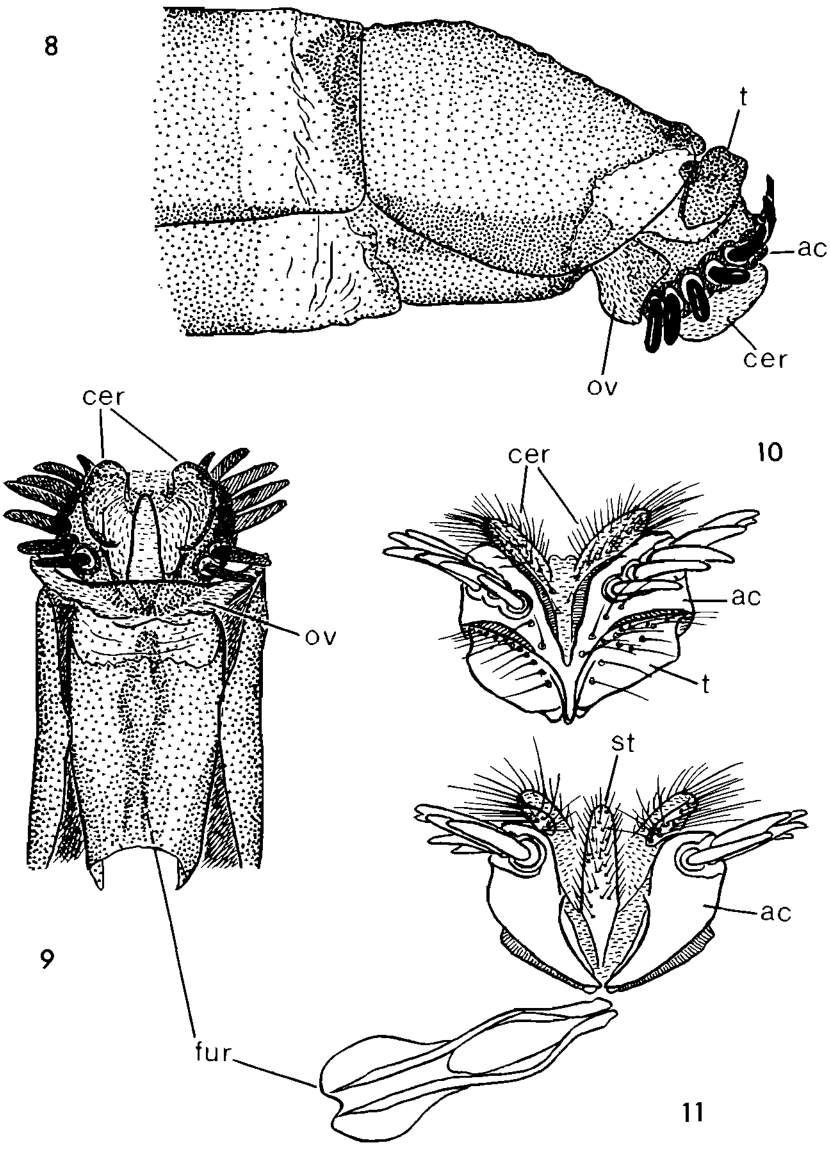
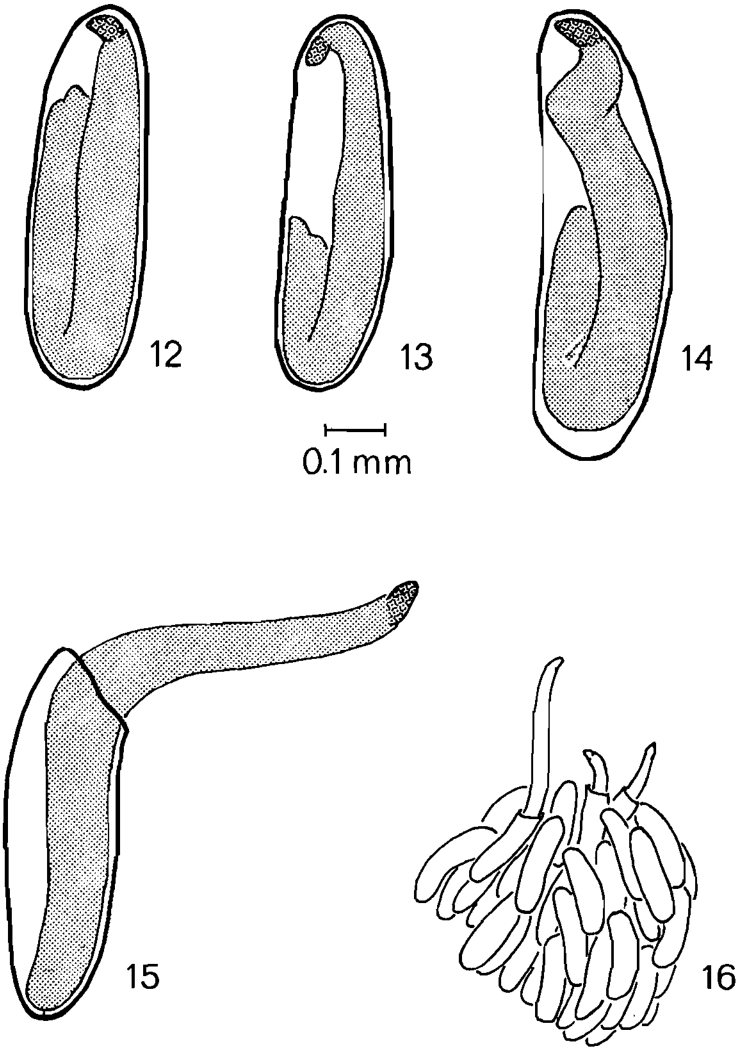


Fig. 7. Female wing.



Figs 8–11. Female abdominal structures: (8) apical part of abdomen in lateral view; (9) ventral view of eighth tergite and sternite, with proctiger; (10, 11) dorsal and ventral view of ninth tergite and acanthophorites. Abbreviations: ac = acanthophorites; cer = cercus; fur = furca; ov = lobe-like projection of distal portion of eighth sternite; st = tenth sternite; t = ninth tergite.



Figs 12–16. (12–15) hatching sequence; (16) partial cluster of eggs, from some of which first-instar larvae are emerging.

variably bordered by brown to dark brown, particularly Cu and the linear vein formed by radial-sector and its continuation as R_{2+3}.

Abdomen swollen over first few segments (about half its length), apical half moderately tapering, more tubular, somewhat laterally compressed over segments seven and eight, terminated by conspicuous circlets of spines. Sternite eight expanded distally into a projecting, transverse, finely setose flange (figs 8, 9, ov) which encloses genital opening ventrally and apparently guides the eggs during oviposition; between this and major basal portion of sternite is an irregular, flexible, membranous area. Postgenital part of abdomen compact, subglobular, comprising basal portion of tergite nine which is divided into two dorsolateral

portions (figs 8, 10, t) narrowly separated in dorsal midline by and firmly attached to a narrow, tongue-like projection continuous with acanthophorites; acanthophorites apparently are modified parts of ninth tergite from whose two basal portions they are separated by narrow slits (figs 8, 10, ac); each acanthophorite curves and widens ventrad, the two almost meeting in midventral line (fig. 11, ac), each bearing a circlet of 6 or 7 strong, flat, bluntly terminated spines set in large sockets with strongly sclerotized walls. Proctiger comprising a pair of projecting, curved, wide cerci (figs 8–10, cer) and what is here interpreted as tenth sternite, an elongate, setose rather weak sclerite of form shown in fig. 11 (st), this sclerite extending dorsally, filling space between cerci, apparently no functional anus present. Dissection of one female preserved in Kahle's fluid did not reveal an obviously discernible alimentary canal; two spermathecae present, these unsclerotized, irregular sacs on fairly short ducts; both tergite and sternite of segments 6, 7 and 8 have a pair of large muscles extending in open V-arrangement between anterior portion of one sclerite and anterior of next one; tergite 8 contains many large muscles extending from its anterior margin to acanthophorites. Furca (fig. 11, fur) well sclerotized.

Colouring in general as in ♂.

Length (excluding antennae) 12,8–16,2 mm; mean of six, 14,1 mm. Wing length 9,0–11,5 mm; mean of five, 10,2 mm.

Material examined: Zululand, 32 km south of Ndumu Game Reserve Camp, 29 November 1971, 100 m altitude, 7 ♀♀ in Natal Museum (coll. M. E. Irwin).

DESCRIPTION OF EGG

Eggs of *Tongamya miranda* pearly white, elongately kidney-shaped, and slightly pointed apically (figs 12, 13, 14). Length from 0,66 to 0,73 mm (mean of twenty, 0,69 mm), and from 0,17 to 0,20 mm wide at broadest part (mean of twenty, 0,19 mm). No pattern was evident on chorion even at magnifications in excess of 10 000×.

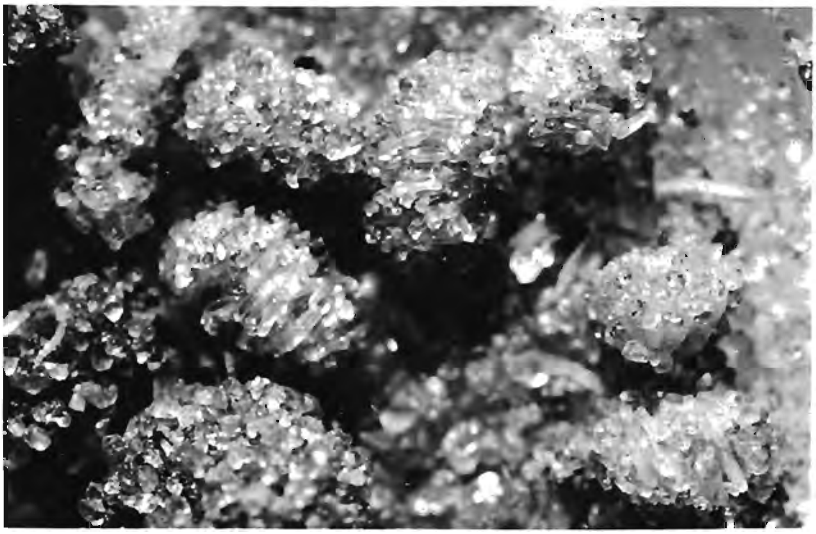


Fig. 17. Egg clusters, after being sieved from sand.

DESCRIPTION OF FIRST-INSTAR LARVA

Morphological terms for head structures are, in part, those advocated by Anthon & Lyneborg (1968).

First-instar larva (fig. 18) yellowish white, 1,18 to 1,36 mm in length (mean of ten, 1,26 mm) and 0,12 to 0,15 mm wide at broadest width (mean of ten, 0,14 mm).

Head (figs 19–23, 27–30) rather cylindrical, in two major sections. *Anterior portion* consists of maxilla (mx) with prominent maxillary palp (mx.p.), five stout, tapering sense organs protruding from a medial grove of the palp (fig. 23); mandibular hooks (md.h.), two pairs (figs 19, 21, 27–30), protruding beneath the anterior section of the head; a crest of uncertain origin or nature, herein termed a cranial crest (c.c.) (figs 19, 27, 30); three mandibular setae (a, b, c) (figs 19, 20); a pair of small setae (d) on the anteriormost portion; a narrowly triangular buccal cavity margined within by a double row of sclerotised serrated ridges (figs 19 inset, 28); and muscle scars on each side of the buccal opening (figs 21, 27, 29). *Posterior portion* of head capsule comprising, antero-dorsolaterad, the antennae, consisting of a smooth depressed disc with a raised, rounded sensory organ slightly centroventrad and two elongate, smaller raised protuberances somewhat posteroventrad of the main rounded raised organ (figs 19, 20, 21, 29, 30); two muscle scars along the ventral line (m.s.) (figs 20, 21, 27); fused labial palp (lb.p.) hidden bearing three pairs of setae (fig. 19 inset); a strong seta (f) slightly posterior to the antennal disc; two strong setae (g, h) postero-dorsad, and one strong seta (i) lateroventrad; one pair of rounded sensory receptors (k) dorsomesad of antennal disc; a pair of small, sharp setae (e) anterior to antennal disc (figs 19, 20, 21); and a pair of small, stout setae (j) laterad of buccal cavity (figs 19, 21); raised, ridged plate (v.p.) ventral, posterior to ventral setae, extending to first thoracic segment (figs 19, 21, 27).

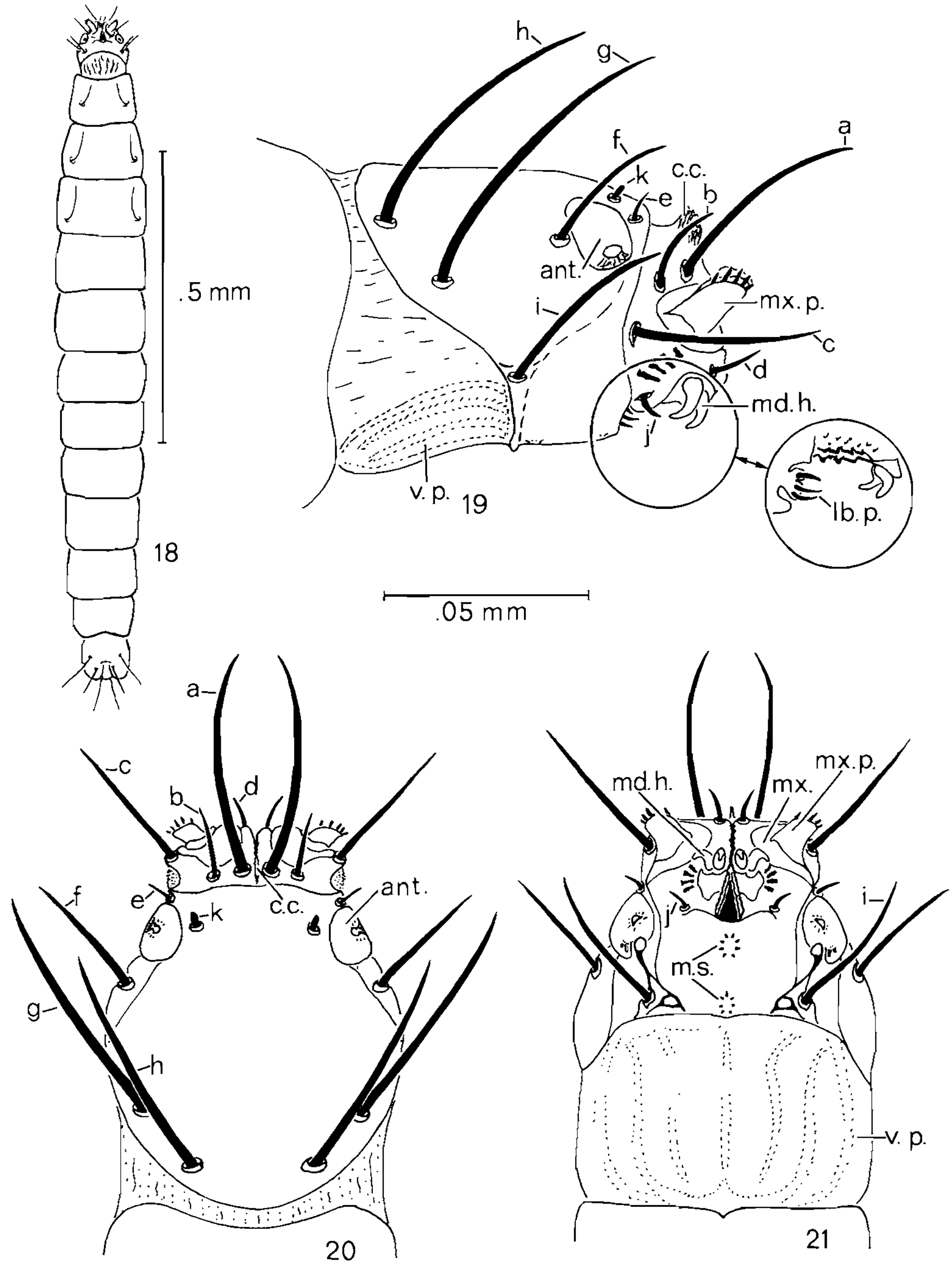
Thorax consisting of three rather uniform segments, each with one pair of setae placed posterolateroventrad (fig. 18).

Abdomen consisting of nine segments, first seven of which bear no setae or other external characteristic structures. Abdominal segment eight contains the spiracles, a set of three spiracular openings on posterolateral portion of tergite (figs 25, 26, 32). The internal mechanism, tentatively diagrammed in fig. 24, consists of a main tracheal trunk, three spiracular chambers, and three spiracles. Ninth abdominal segment trilobate, two ventral lobes and a dorsal lobe (figs 25, 26, 31). Each ventral lobe bears two large setae, and the dorsal lobe has two sets of setae as illustrated (figs 25, 26).

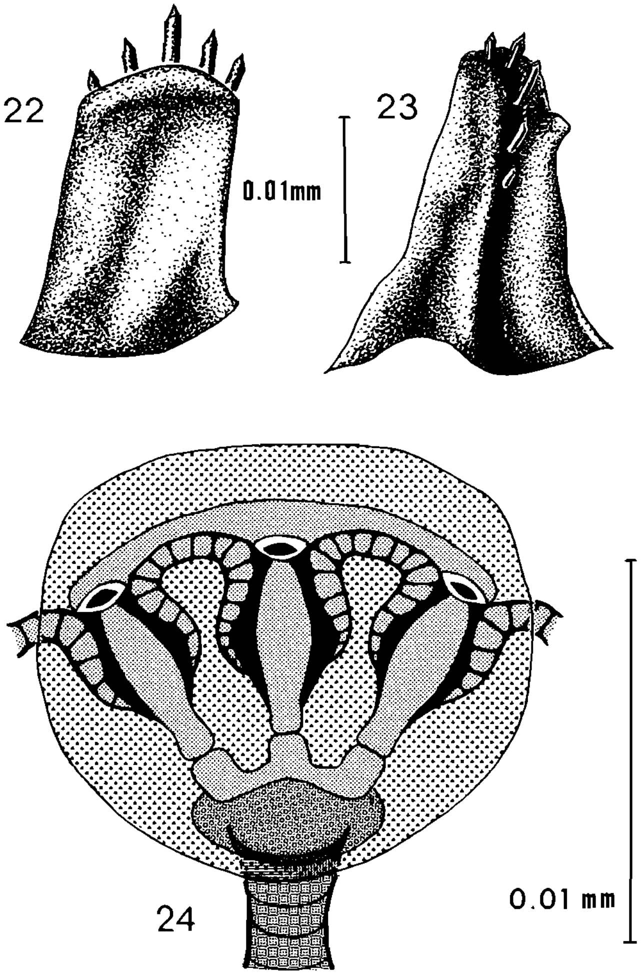
HABITAT

Females of *Tongamya miranda* were observed and collected 32 km south of the Ndumu Game Reserve camp, on a broad, dry outcrop of coarse, white sand. Surrounding this was an expanse of finer, rusty-red sand. The vegetation within the area of white sand was sparse, a mixture of small-leaved trees and thorny scrub. *Senecio barbetonicus* Klatt, a succulent understory shrub, was dominant in the more densely vegetated surroundings, and in the more open areas grasstufts (*Panicum* sp.) were scattered.

All the females were associated with the grasstufts, found either within them or observed flying from one tuft to the next. Their flight was slow and the female would seemingly impact with the grass stems without reducing speed, and cling with its unusually long hind



Figs 18–21. (18) First-instar larva, ventral view; (19–21) head capsule, first-instar larva, (19) lateral view, insert: sagittal longitudinal view of mouth, (20) dorsal view, (21) ventral view; a–c = mandibular setae, d–k = other cephalic setae, ant. = antenna, c.c. = cranial crest, lb.p. = fused labial palps, m.s. = muscle scars, md.h. = mandibular hook, mx. = maxilla, mx.p. = maxillary palp, v.p. = ventral plate.

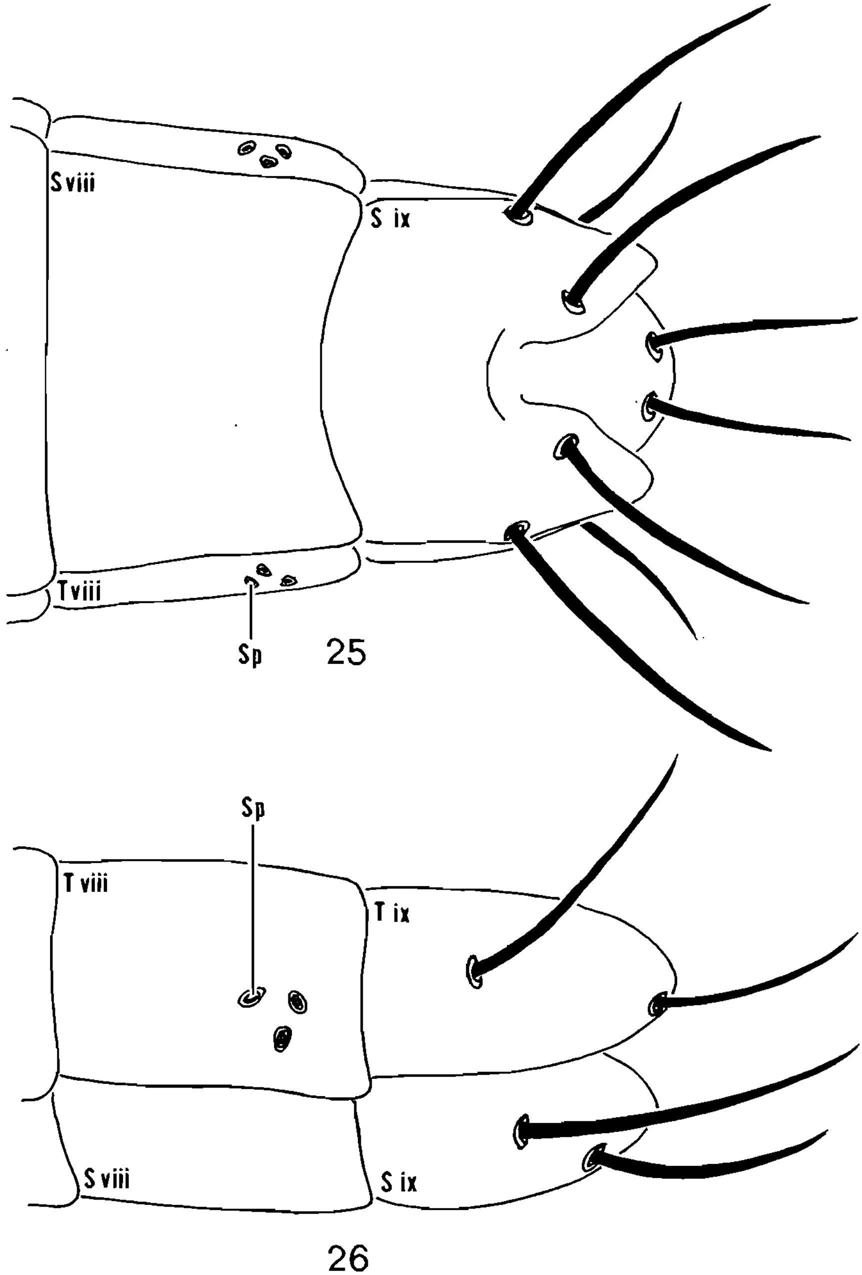


Figs 22–24. (22–23) maxillary palp of first-instar larva, (22) lateral view, (23) posterodorsal view; (24) schematic of posterior spiracles.

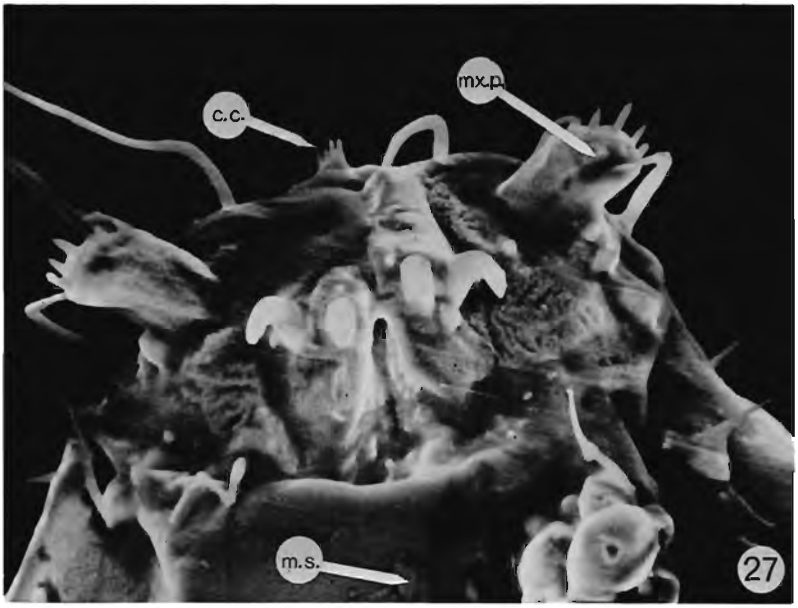
legs. The females were darkly coloured and contrasted well against the straw-coloured grasstufts and the white sand. Males were not observed even though over five hours were spent in pursuit of these flies.

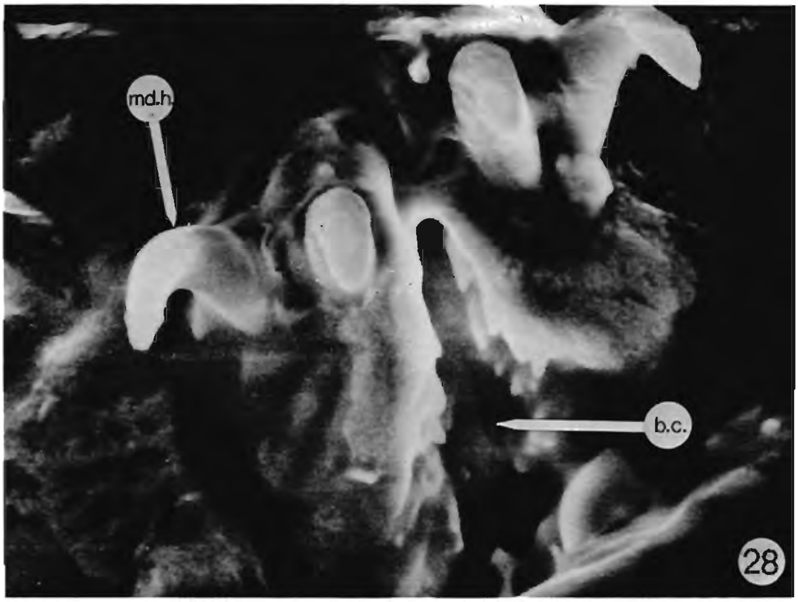
OVIPOSITION

Oviposition by *Tongamya miranda* was not observed by the authors. Live females brought into the laboratory deposited eggs in a sand substrate when confined to a terrarium. Seven intact clusters of eggs laid by a single female were examined. The smallest contained 56, the largest 148 eggs, and the mean for all seven clusters was 101 eggs. Fourteen smaller clusters were also recovered from the same female, but these were obviously broken apart

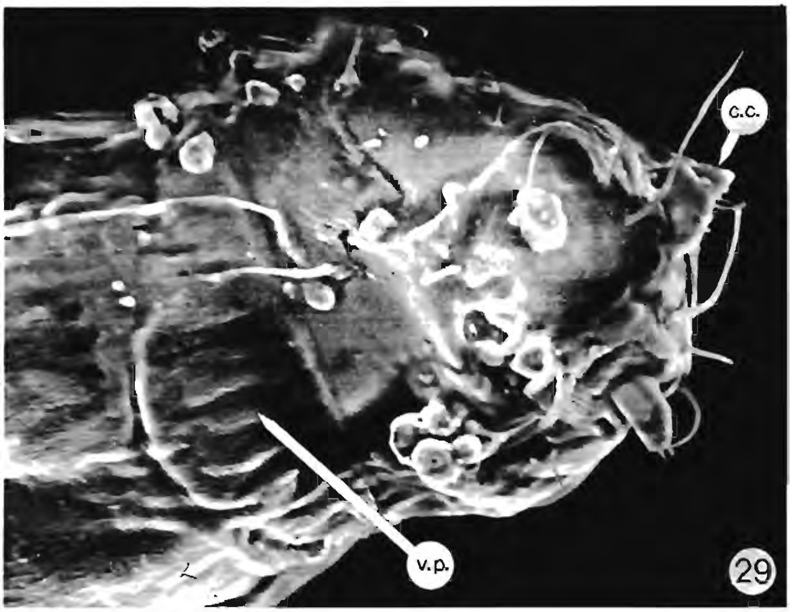


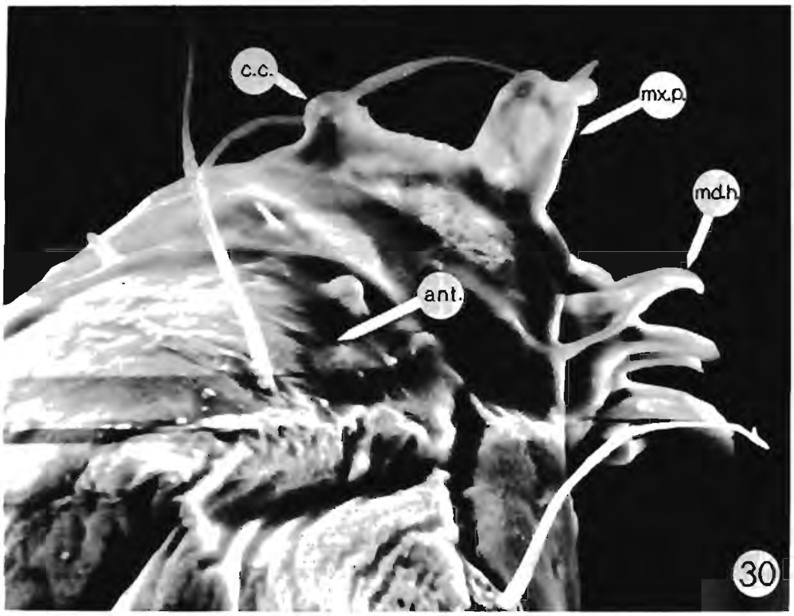
Figs 25–26. Abdominal segments viii and ix of first-instar larva, (25) ventral view, (26) lateral view.



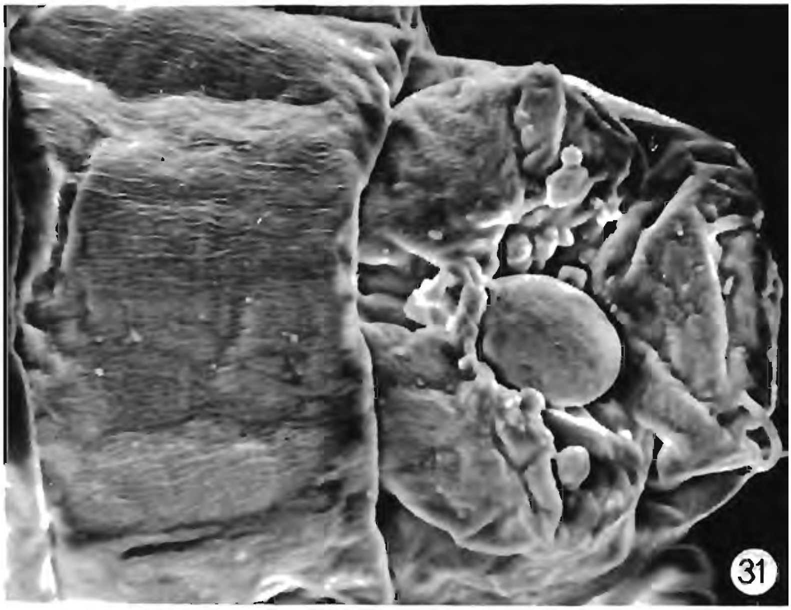


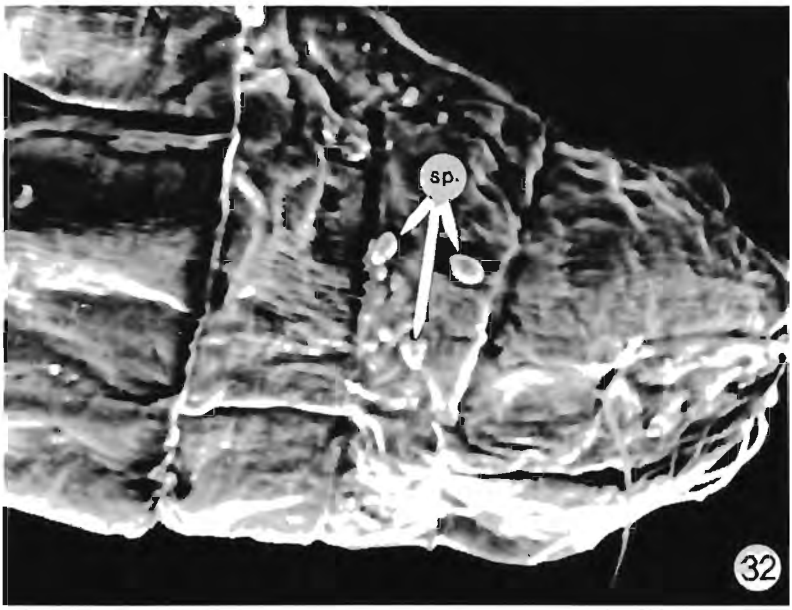
Figs 27–28. The series of six photomicrographs (figs 27–32) were produced by a Hitachi stereoscan, model SSN–2, Scanning Electron Microscope housed at the University of Natal, Pietermaritzburg; (27) anterior portion of head capsule, ventral view, 1590×; (28) buccal cavity and mouth hooks of first-instar larva, ventral view, 7014×; b.c. = buccal cavity, c.c. = cranial crest, m.s. = muscle scar, md.h. = mandibular hook, mx.p. = maxillary palp.





Figs 29–30. (29) head capsule, first-instar larva, lateroventral view, 862× ; (30) head capsule, anterolateral view, 1613× ; ant. = antenna, c.c. = cranial crest, md.h. = mandibular hook, mx.p. = maxillary palp, v.p. = ventral plate.





Figs 31–32. Abdominal segments viii and ix, first-instar larva, (31) ventral view, 900×; (32) lateral view, 690×; sp. – spiracles.

and originally formed four or five additional larger clusters. Each cluster was composed of eggs arranged in more or less a single layer, 2 mm wide by 3 mm long (fig. 16). The clusters were curved, fitting the contour of a slightly concave pit (figs 16, 17).

The eggs in the clusters were cemented together and those at the extremities had sand particles adhering to them. When sieved from the sand, the eggs were no longer sticky even though they remained cemented together.

From this scant evidence, it appears that the female forms a small pit in the sand and then proceeds to lay eggs, one on to the next until the pit is filled one layer deep, at which time she withdraws her abdomen, then reinserts it, forming a new pit. One pinned female specimen had two eggs extruding from her ovipositor; this suggests that more than one egg may be laid at a time. From the muscular arrangement in the female abdomen it appears as though at least the apical half of the abdomen might be inserted into the sand when ovipositing.

HATCHING SEQUENCE

Although hatching was not directly observed, several egg clusters preserved in Kahle's fluid were dissected and examined, and these showed the various stages in the hatching sequence quite clearly.

The developed embryo was doubled over, its anterior end extending slightly forward of its posterior end just prior to hatching (fig. 12). With body contortions it thrust its head end further forward and, at the same time, the hind end backward, creating pressure at the anterior end of the egg capsule (figs 13, 14). It probably ruptured the anterior end of the egg chorion by means of its two pairs of mandibular hooks (figs 19, 21, 27, 28), and emerged head first from the egg (fig. 15).

Upon emergence, the first-instar larva was able to erect itself, its caudal end adhering to a convenient substrate. It would wave its body about for several minutes, then crawl off like an inch-worm or looper caterpillar (family Geometridae).

LARVAL FEEDING

The larvae were observed to pass one another without any hostile act, but some larvae, placed in a small dish containing sand, were examined several weeks later and nearly all were found to be punctured about the middle with a darkened area surrounding the puncture. They were apparently victims of cannibalistic attacks.

REVIEW OF APIOCERID BIOLOGY

Only two previous accounts of apiocerid bionomics have been reported (English, 1947; Cazier, 1963), both of which dealt with the genus *Apiocera* (subfamily Apiocerinae). This brief account of the bionomics of *Tongamya* (subfamily Megascelinae) represents the third for the Apioceridae and the first for the Megascelinae. It therefore seems desirable to compare what is known about the bionomics of these two subfamilies.

Oviposition. While a female of *Apiocera* can lay as many as five eggs per cluster, *Tongamya miranda* lays as many as 150 eggs per cluster. *Apiocera* lays upwards of 38 (*A. painteri*) and 69 (*A. maritima*) eggs per female. *T. miranda* lays upwards of 1 000 eggs per female. Eggs of *Apiocera* were about 2 mm long and 1 mm wide. *T. miranda* eggs averaged

about 0,7 mm in length and 0,2 mm in width, considerably smaller than those of *painteri*, although females of both species were about 14 mm in length.

Hatching sequence. Cazier gave a detailed account of hatching for *Apiocera painteri*. The embryo is bent double within the egg just prior to hatching, a feature in common with *Tongamya*. The mandibular hooks of *A. painteri*, and apparently *T. miranda*, rasp at the inside of the egg chorion, eventually weakening it to the point that the caudal end (in *painteri*) or head end (in *miranda*) applies sufficient pressure to burst the chorion. The larva then emerges, caudal end first in the case of *painteri*, head end first in *miranda*.

Larva. Cazier did not describe the first-instar larva of *painteri* in detail and English had only the later instar larvae of *maritima* available to describe. Since only the first-instar larva of *miranda* was available at this writing, little can be compared.

Morphological differences between the first-instar larva of *miranda* and the later instar larvae of *maritima* are so great that a comparison of the figures is necessary (*see* English, 1946, p. 300, figs 6, 7, 8, 12, 13).

A. painteri first-instar larva was about 4 mm long while the first-instar larvae of *T. miranda* averaged about 1,25 mm in length. A feature of larval *maritima* and *painteri* is the lack of intercalary constrictions between the apical 1–4 and terminal 9–12 segments, contrasting with the presence of obvious constrictions between the intermediate segments. On the other hand, the larva of *miranda* has all of the junctions between the segments moderately constricted. The caudal segment of *painteri* was evenly rounded while that of *miranda* was trilobate (fig. 25).

Movement of first-instar larvae of *painteri* was, like *miranda*, immediate upon emergence, but, unlike *miranda*, was slow and erratic. Larvae of *painteri* were given a variety of foods in the laboratory, but nothing was eaten. Specimens of *miranda* apparently ate one another after having been together for a week or more.

ACKNOWLEDGEMENTS

The following are gratefully acknowledged for their assistance: Mrs Elsa Pooley, Ndumu Game Reserve, for plant identification; and Mrs Mary Carter, Electron Microscope Unit, University of Natal, Pietermaritzburg, for assistance and production of the photographs used in figs 27–31.

LITERATURE CITED

ANTHON, H. & LYNEBORG, L., 1968. The morphology of the larval head capsule in Blepharoceridae (Diptera). *Spolia. zool. Mus. haun.*, **27**: 1–56.

CAZIER, M. A , 1963. The description and bionomics of a new species of *Apiocera*, with notes on other species (Diptera: Apioceridae). *Wasmann J. Biol.*, **21** (2): 205–234.

ENGLISH, K. M. I., 1946. Notes on morphology and biology of *Apiocera maritima* Hardy (Diptera; Apioceridae). *Proc. Linn. Soc. N.S.W.*, **71** (5–6): 296–302.

STUCKENBERG, B. R., 1966. A remarkable new genus and species of Apioceridae in South Africa (Diptera). *Rev. Zool. Bot. Afr.*, **73** (1–2): 106–120.

——— 1968. A redescription of '*Asilus*' *alastor* Walker, and its transfer to the genus *Apiocera* (Diptera: Apioceridae). *Ann. Natal Mus.*, **20** (1): 123–125.

Date received: 25 April 1972